Available online at https://www.ijasrd.org/

International Journal of Advanced Scientific Research & Development

Vol. 05, Iss. 07, Ver. I, Jul' 2018, pp. 75 – 80

e-ISSN: 2395-6089
p-ISSN: 2394-8906

SUSTAINABLE LOW COST AND GREEN TEST HOUSE

Dr. R. Mathiyazhagan[1], Dr. S. Palanivelraja[2], Dr. R. Sheela[1*], Dr. T. Ramesh[1*], and **Dr. R. Rajendran[3]**

[1] Assistant Professor, Department of Civil Engineering, Annamalai University, Annamalai Nagar, Chidambaram, Tamil Nadu, India.

[2] Professor, Department of Civil Engineering, Annamalai University, Annamalai Nagar, Chidambaram, Tamil Nadu, India.

[3] Assistant Professor, Department of Sociology, Annamalai University, Annamalai Nagar, Chidambaram, Tamil Nadu, India.

ARTICLE INFO

Article History:

Received: 26 Jul 2018;
Received in revised form: 06 Aug 2018;
Accepted: 06 Aug 2018;
Published online: 10 Aug 2018.

Key words:

Sustainable Low Cost,
Green Test House,
Shelter,
Technological Achievements,
Economic Growth,
Population Growth.

ABSTRACT

Shelter is a basic human need. Building and habitats are designed and constructed to fulfill this. Since the industrial revolution, the world has witnessed incalculable technological achievements, economic and population growth, and ever increasing use of natural resources. Increased urbanization as seen today is a result of this overall growth. The green cover and ground water resources have been forced to give way to these rapidly developing urban structures. Energy is another major resource that is being consumed indiscriminately to meet the power demand for air-conditioning, lighting and equipment. Most conventional practitioners of modern design and construction, find it easier to develop buildings in a vacuum-as if nature, place and context do not exist. Most of today's architectural expressions demonstrate human dominance over nature. Inefficient and overuse of limited natural resources is evidently rampant. On the other hand, sustainability demands restraint over use of natural resources. Sustainability in the sector of building design is a complex concept of multidisciplinary character. Its realization requires an integrated design approach involving all key stakeholders in the process of designing, planning and constructing buildings.

Cite this article as: Mathiyazhagan, R., Palanivelraja, S., Sheela, R., Ramesh, T., & Rajendran, R., "Sustainable Low Cost and Green Test House". *International Journal of Advanced Scientific Research & Development (IJASRD), 05* (07/I), 2018, pp. 75 – 80. https://doi.org/10.26836/ijasrd/2018/v5/i7/50712.

*** Corresponding Author:** Dr. R. Sheela, sheelaragu2015@gmail.com

INTRODUCTION

The basic principles of sustainable design or 'green design' as it is popularly known, are to aim for maximum resource conservation, to enhance efficient utilization of non-renewable resources by adopting efficient systems, and to maximize use of renewable forms of energy as well as to recycle and reuse resources. These principles need to be applied throughout the building life-cycle e.g. during the site planning and development stage, building planning and construction, and building operation and maintenance.

1.1 Recommended Practices of Sustainable House Construction

- Restrict area and time for night time illumination
- Clearly identify the actual purpose of lighting to determine minimum acceptable levels
- Use energy-efficient lamps and ballasts
- Use of appropriate control strategies
- Use renewable energy sources for lighting and other outdoor power

MATERIALS AND METHODS

2.1 Design of Solar Paneled Pyramidal Roof Rural House

The Pyramidal house is a wall-less low-cost sustainable home using pre-cast roofing components, 60% economy could be achieved in the cost of the Pyramidal Home construction. Figure 5.1 shows the plan and elevation of the constructed solar paneled pyramidal model house in the Vilathur village. Total land area for the proposed house construction including frontage, side and rear side opening for ventilation is 58 sq.m. The plinth area of the house is 26.2 sq.m. (5.18 m x 5.18 m). Six windows are planned to have good ventilation inside the house with a size of 0.9m x 0.9m.

As this house is in pyramidal shape roofing, the height of the wall is designed up to 1.52m and the height of the pyramidal portion of the roof is 1.52 m with an inclination angle of 38^{o}. The topmost portion of the pyramidal roof is having 1.22 m x 1.22m flat portion to accommodate the solar panel.

The soil available in this village is sandy clay soil. Hence the depth of foundation is designed for 0.9m and size of the foundation is 0.75m x 0.75m. This house is designed by adopting limit state method. The design results for this house is as follows:

2.2 Column Design

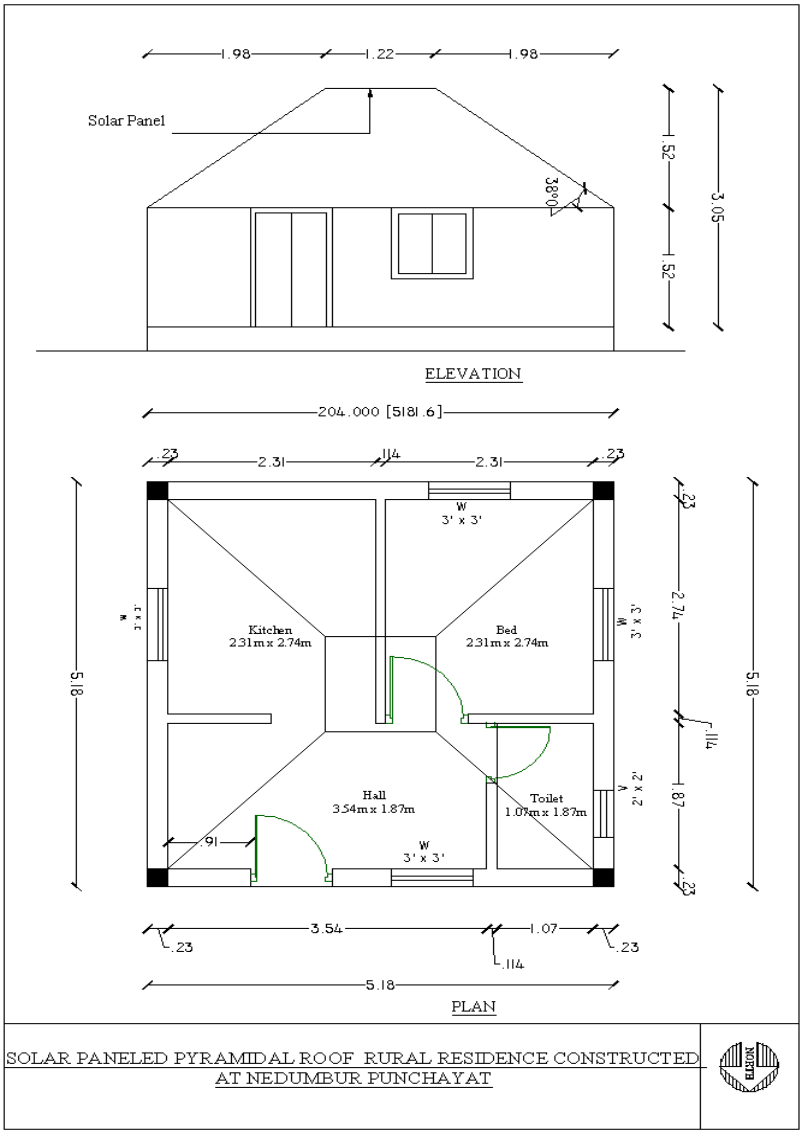
Column size = 0.23 m by 0.23 m square column
Number of columns = 4 nos.
Reinforcement in the column
Main rods = 8 mm
Tie rods = 6 mm with 230 mm spacing
Concrete Mix = 1:2:4 (M15)

2.3 Roof Design

Roof thickness = 75 mm
Reinforcement in the roof

Main rods	= 8 mm with a spacing of 300 mm
Distribution rods	= 6mm with a spacing of 300 mm
Concrete Mix	= 1:2:4 (M15)

Figure – 1: *Plan and Elevation of Solar Paneled Pyramidal Roof House at Vilathur Village*



RESULTS & DISCUSSION

3.1 Construction of Solar Paneled Pyramidal Roof House

One of the primary requirements of a green building is that it should have optimum energy performance and provide the desirable thermal and visual comfort. Three systems are adopted to achieve green building concept in this house and they are described in the following sections.

3.2 Solar Passive Techniques in a House Construction

The solar paneled pyramidal roof house was constructed in hot climate and it is oriented east to west direction with larger size windows to have less radiation inside the house. Three windows of size 0.9 m x 0.6 m and one window of size 1.2 m x 0.6 m are

provided. Apart from that two ventilators are constructed using fly ash bricks to allow the natural ventilation inside the house. This house roof is constructed in pyramidal shape to have minimum sunlight effect on the building. The total roof area of the pyramidal portion is 16.4 sq.m. with an angle of 38º inclination with the horizontal.

3.3 Use of Low Energy Materials and Methods of Construction

An architect should also aim at efficient structural design, reduction of use of high energy building materials such as glass, steel etc. and reducing transportation energy. Use of environmentally sensitive construction materials and techniques reduce embodied energy content of buildings. Some common products are - use of flyash in building materials e.g. use of blended cement for structural systems; use of flyash based bricks and blocks etc; use of ferrocement and precast components for columns, beams, slabs, staircases, lofts, balconies, roofs etc; use of wood substitutes for doors/ windows/ cabinet frames and shutters

In this type of house fly ash bricks are used to construct the outer walls of 0.23 m thickness and partition walls of 0.125 m thickness. The compressive strength of the bricks used for the construction of wall is 81 N/mm2. In order to have cooling effect, the house is plastered with lime mortar and white washing also done only with lime powder. The pyramidal roof was constructed with ferrocement of 75 mm thickness. Figures 5.2 and 5.3 show the construction stages of pyramidal roof during construction. Flooring was done with cement mortar of 1:5, waste brick coarse aggregates of 20 mm and thickness of flooring 100mm with 25mm floor finishing. In order to have less heat effect, the floor was finished with red oxide mix. The details of materials used and cost of construction of the pyramidal sustainable home is given in Table 1.

Table – 1: *Materials Used and Costing for Sustainable House*

Material	Material Required	Rate per Material (in Rs.)	Total Amount (in Rs.)
Fly ash bricks	2600 nos	2.50	6500
Cement	30 Bags (1500 kg)	210	6300
Steel	8 mm & 6 mm– 150 kg	34	5100
Sand	5 units	800	4000
B. G Metal & Metal Chips	LS		4500
Window with country wood	0.9 x 0.6 size – 3 nos 1.2 x 0.6 size – 1 no.	750	3000
Ventilators using Brick masonry	0.9 x .45 – 2 nos	It is only labour cost	
Door with country wood	1 No (0.9 m x 1.5 m)	2000	2000
Labour Charges	LS		5900
White washing with lime mortar			700
Total Cost of the Building			38,000

Table – 2: *Solar System Installed and their Cost for Sustainable House*

Description of Solar system	Cost in Rs.
Solar panel with photo electric cell	20,000
Solar lantern	4,500
Solar Cooker	2,500

Table – 3: *Reduction of Cost of Building Materials for SPR House*

Sl. No.	Building material required for IAY house by conventional method	Rate	Total Cost (Rs)	Building material required for SPR house by Ferrocement roof method	Rate	Total Cost (Rs)	Reduction of Cost (Rs)
1	Bricks- 6500 nos	3.00	19,500	Bricks – 2600 Nos	2.50	6,500	13,000
2	Cement- 50 bags- 2500 Kg	210	10,500	Cement - 30 bags – 1500 Kg	210	6,300	4,200
3	Steel-250 kg	34	8,500	Steel – 150 kg	34	5,100	3,400
Total			**38,500**	**Total**		**17,900**	**20,600**

Figure – 2: *Pyramidal House Roof Reinforcement*

Figure – 3: *Solar Lighting inside the Pyramidal Roof House*

CONCLUSION

Table 3 presents a tentative cost reduction of important building materials for SPR house when compared to conventional IAY house. By adopting the ferrocement roof technique, a reduction of 53% can be achieved in the cost of building materials for 26 sq.m SPR house without compromising on the safety, durability and aesthetic aspect of the house.

REFERENCES

[1] Climate Change 2007: The Physical Science Basis – Summary for Policymakers, IPCC, 2007, p. 5.

[2] http://web.worldbank.org.

[3] Buildings and Climate Change – Status, Challenges and Opportunities, United Nations Environment Programme, Chapter 2.1, p. 7.

[4] Corporate Sustainability Report 2003–04, TATA Steel; www.tatasteel.com/sustainability_05/environmental/ev_09.htm.

[5] http://www.bee-india.nic.in/sidelinks/EC%20Award/eca05/03Cement.

[6] UNDP Project Document, Government of Bangladesh, Improving kiln efficiency in the brick making industry, 2006, p. 50.

[7] www.chaarana.org/ecofriendlyhouses.html